CXVIII.—*The Nature of the Alternating Effect in Carbon Chains. Part XIII. The Nitration of Some γ-Phenylpropylamine Derivatives.*

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FOR reasons which will be apparent from the introductory statement of Part X (this vol., p. 250), we have studied the nitration of γ-phenylpropylammonium nitrate and of γ-phenylpropyltrimethylammonium picrate. The proportions of *m*-isomeride formed are given in the lowest line of the following table, the other numerical values being taken from previous papers (*loc. cit.*, and J., 1926, 2441) to illustrate the effect of homology.

Nitration in Nitric Acid at 0° *to* — 15°.

	$C_6H_5\cdot[CH_2]_x\cdot NH_2HX$ (primary).	$C_6H_5\cdot[CH_2]_x\cdot NMe_3\}X$ (quaternary).
$x = 1$	49%	88%
$x = 2$	12%	19%
$x = 3$	3%	5±2%

[The limits attached to the figure for the last quaternary salt arise from the circumstance that the proportion of nitrated salt which cannot be separated from the inorganic salts produced on neutralising the nitration solution is of the order of magnitude of the quantity of *m*-derivative formed; therefore, the unknown quantity of *m*-compound which may be contained in this unseparated portion cannot be neglected in comparison.]

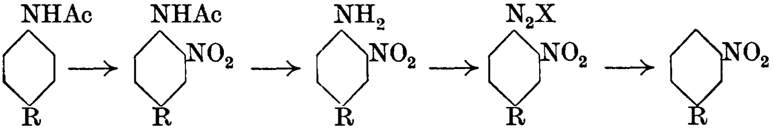
EXPERIMENTAL.

γ-Phenylpropyltrimethylammonium Picrate.—γ-Phenylpropylamine was prepared by Michaelis and Jacobi's method (*Ber.*, 1893, **26**, 2160) and purified by conversion into the oxalate. This salt (10 g.) was boiled for a few minutes with ethyl alcohol (380 c.c.) and anhydrous sodium carbonate (38 g.), and the cooled mixture treated with 41 c.c. of methyl sulphate. The reaction was completed by boiling for 2 hours, and after the addition of water the excess of methyl sulphate was destroyed and the greater portion of the alcohol was removed by distillation. The aqueous solution (250 c.c.)

was extracted twice with ether to remove tertiary bases, and, after expulsion of the dissolved ether by boiling, was mixed with a saturated solution of sodium picrate. The salt which separated crystallised from aqueous alcohol in orange-yellow prisms, m. p. 121° (Found: C, 53·2; H, 5·6. $C_{18}H_{22}O_7N_4$ requires C, 53·2; H, 5·5%).

γ-p-*Nitrophenylpropyltrimethylammonium picrate* was prepared from γ-*p*-nitrophenylpropylamine (below) by the same method (Found: C, 47·7; H, 4·8. $C_{18}H_{21}O_9N_5$ requires C, 47·9; H, 4·7%). It forms yellow prisms, m. p. 138°.

γ-m-*Nitrophenylpropyltrimethylammonium Picrate*.—This was synthesised, by the following process, from the *p*-isomeride, which was first converted into the corresponding *p*-acetamido-compound [R = $\cdot CH_2\cdot CH_2\cdot CH_2\cdot \overset{+}{N}(CH_3)_3$]:



A solution of the *p*-nitro-picrate (10 g.) in concentrated hydrochloric acid (200 c.c.) was shaken with benzene to remove the picric acid and then reduced with stannous chloride (25 g.) at 100° during 0·75 hour. After dilution, the tin was removed as sulphide and the solution evaporated to dryness. The *dihydrochloride* thus obtained was acetylated by boiling with acetic anhydride (20 c.c.) and anhydrous sodium acetate. The residue obtained on evaporation to dryness was dissolved in water and the solution mixed with saturated sodium picrate solution. Very little picrate was precipitated by this means, and the solution was therefore evaporated to dryness and the residue extracted with acetone. The salt dissolved by the acetone was crystallised first from water and then from alcohol (m. p. 153°; yield 50%). The γ-p-*acetamidophenylpropyltrimethylammonium picrate* so obtained was nitrated at — 18° during 2 hours with 7·5 parts of nitric acid (*d* 1·49). The solution was allowed to warm to 0° during 15 minutes, mixed with two volumes of ice (picric acid was precipitated), and neutralised with concentrated sodium hydroxide solution (picric acid redissolved and a picrate crystallised). γ-m-*Nitro*-p-*acetamidophenylpropyltrimethylammonium picrate* separates from alcohol in prisms, m. p. 140° (Found: C, 47·9; H, 5·0. $C_{20}H_{24}O_{10}N_6$ requires C, 47·3; H, 4·8%). It was boiled gently with ethyl alcohol (40 parts) and concentrated sulphuric acid (4 parts) until the volume was reduced to one-third; a further quantity of alcohol was then added and the boiling continued until ethyl acetate ceased to be contained in the distillate. The solution was diluted with fresh alcohol, neutralised with anhydrous sodium carbonate, and filtered, and the residue was well washed with alcohol. The combined filtrates were evaporated to a small bulk, acidified with concentrated sulphuric acid, and diazotised at 0° with a saturated solution of sodium nitrite. The solution was then heated at 100° until nitrogen ceased to be evolved, treated with excess of anhydrous sodium carbonate and sodium picrate, and evaporated to dryness. The residue was extracted with boiling acetone, and the residue obtained on evaporating the acetone was re-extracted with hot ethyl acetate, from which the m-*nitro-picrate* separated in yellow needles, m. p. 156° (Found: C, 48·2; H, 4·8. $C_{18}H_{21}O_9N_5$ requires C, 47·9; H, 4·7%). Its constitution was proved by oxidation (below).

Nitration of γ-Phenylpropyltrimethylammonium Picrate.—The picrate (5·00 g.) was added during 1 hour to 25 c.c. of nitric acid ($d^{10°}$ 1·49) at − 15°, and the mixture was then kept at or below this temperature for 1 hour and thereafter allowed to warm to 5° during 0·5 hour. Ice was added, and the solution rendered alkaline with concentrated sodium hydroxide solution at − 10°. The nitro-derivative was collected, and crystallised from methyl alcohol and ethyl acetate until no further crops of pure *p*-isomeride (total 47%) could be obtained. All the solutions were then evaporated to dryness and the residues extracted in a Soxhlet apparatus with acetone; the residues from the acetone were again extracted with ethyl acetate, the final product being washed with a very little water. The yield was 49%, making a total yield of mononitro-products equal to 96%. The mixture of isomerides (Found: C, 48·3, 48·4; H, 5·0, 4·9. Calc.: C, 47·9; H, 4·7%) was oxidised in 84% yield to nitrobenzoic acids by permanganate, and the *p*- and *m*-acids were estimated by separation as described in previous parts of this series (*p*-, 66%; *m*-, 6·5%).

Two parallel experiments in which the pure *p*- and *m*-nitro-picrates were separately oxidised to the corresponding nitrobenzoic acids by means of permanganate gave yields amounting to 81% and 80%, respectively. This shows that there is no selective destruction of the *m*-isomeride during the oxidation mentioned in the preceding paragraph, and that the proportion of *m*-nitrobenzoic acid represents the proportion of *m*-nitro-picrate in the mixture oxidised.

On this assumption, there is 3·2% of *m*-isomeride in the 96% of mononitration product accounted for. The total formed could not be more than 7·2%, and is very unlikely to be so much. The proportion of *p*-isomeride is $47 + 0·49 \times 66 \pm 2 =$ about 81%.

Nitration of γ-Phenylpropylamine.—The base was run through a capillary tube into 7·5 parts of nitric acid (*d* 1·49) at − 15°. Two hours were allowed for the nitration and the nitric acid solution was then warmed to 5° and mixed with ice.

γ-p-*Nitrophenylpropylammonium nitrate* (48·5%) was obtained in needles, m. p. 200°, from the crystalline mixture of nitrates by crystallisation from water. The corresponding *chloride* forms prisms, m. p. 165° (Found : C, 50·2; H, 6·2. $C_9H_{13}O_2N_2Cl$ requires C, 49·9; H, 6·0%). Small amounts of neutral and acid oxidation products were removed from the combined liquors by extraction with ether, and the remainder of the mononitration product (40%) was then isolated by basifying it with sodium hydroxide and again extracting it (Found for the corresponding nitrates : C, 45·0; H, 5·1. Calc. : C, 44·4; H, 5·4%). This was oxidised in 66% yield to a mixture of nitrobenzoic acids, the *p*- and *m*-acids in which were estimated by separation as before (*p*-, 55%; *m*-, 6%). The pure *p*-acid, on oxidation under the same conditions, gave *p*-nitrobenzoic acid in 67% yield.

The proportions of *m*- and *p*-isomerides calculated on the total mononitration product are therefore *m*-, 2·7%; *p*-, 73%.

The authors desire to thank the Royal Society for a grant which has covered part of the cost of this work.

THE UNIVERSITY, LEEDS. [*Received, January* 12*th*, 1927.]